

# **Accuracy Characteristics for ZME Risk Reduction Scenario Hours 1930-2100**

## **1 Introduction**

This document contains scenario characteristics for hours 1930 to 2100 GMT recorded on October 5, 2000 at Memphis ARTCC (ZME). Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, and flight plan adherence. Definitions of the provided scenario characteristics are provided in Reference[1].

## **2 Reference**

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

## **3 Center Airspace**

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the October 5, 2000 ACES chart cycle. Information provided in Table 1 was gathered from running URET PRE and local knowledge.

**Table 1: Center Airspace Characteristics**

Metric	Definitions	Count
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	10
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

## 4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

### 4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

**Table 2: Count of Current Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	63	42
$5 \leq d < 10$	76	45
$10 \leq d < 15$	97	51
$15 \leq d < 23$	205	118
$23 \leq d < 30$	164	90
Total	605	346

**Table 3: Count of Trial Plan Aircraft Encounters**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	63	40
$5 \leq d < 10$	76	42
$10 \leq d < 15$	97	46
$15 \leq d < 24$	227	124
$24 \leq d < 30$	142	76
Total	605	328

## 4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

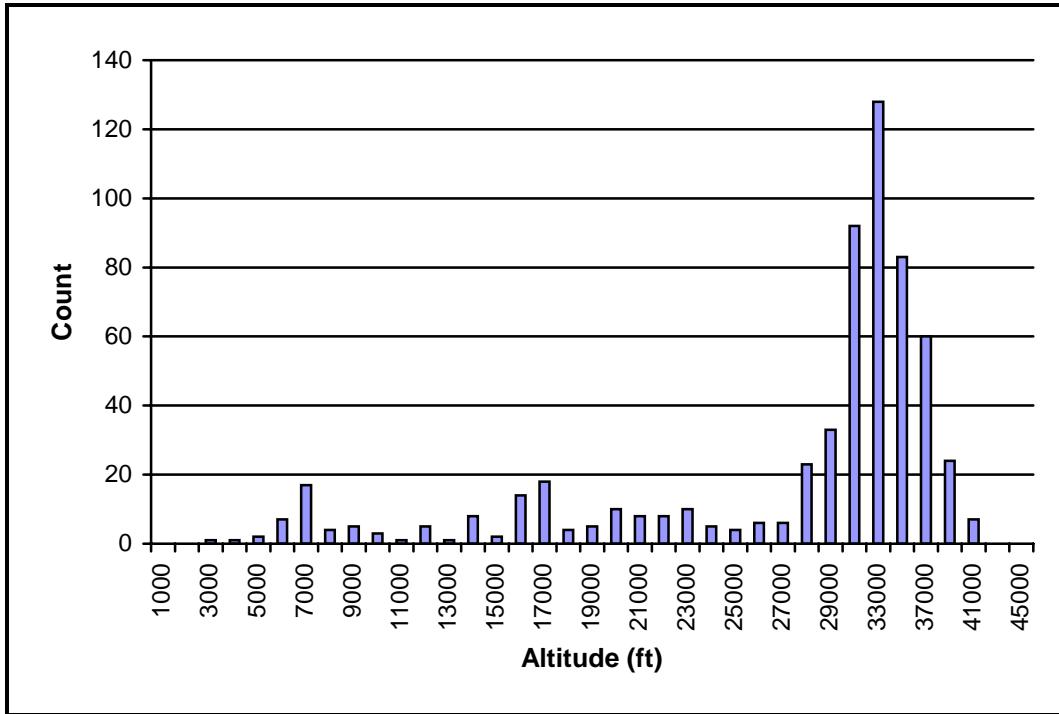


Figure 1: Aircraft to Aircraft Encounters by Altitude

## 4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 4: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	44	71	31	18	164
Descend-Descend	13	2	1	4	20
Climb-Climb	17	1	2	0	20
Cruise-Climb	63	37	38	32	170
Cruise-Descend	63	38	44	35	180
Climb-Descend	15	4	7	6	32
Unknown	15	2	1	1	19
Total	230	155	124	96	605

## 5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

### 5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

**Table 5: Count of Current Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts <sup>1</sup>	148	118
$d = 0^2$	4	2
$0 < d < 7$	211	146
$7 \leq d < 9$	58	45
$9 \leq d < 11$	35	26
$11 \leq d < 16$	91	62
$16 \leq d < 30$	346	242
Total	893	641

**Table 6: Count of Trial Plan Airspace Encounters by Horizontal Separation**

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts <sup>3</sup>	148	114
$d = 0^4$	4	2
$0 < d < 8$	247	167
$8 \leq d < 11$	57	43
$11 \leq d < 13$	36	22
$13 \leq d < 19$	138	96
$19 \leq d < 30$	263	176
Total	893	620

<sup>1</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>2</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

<sup>3</sup> This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

<sup>4</sup> This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

## 5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

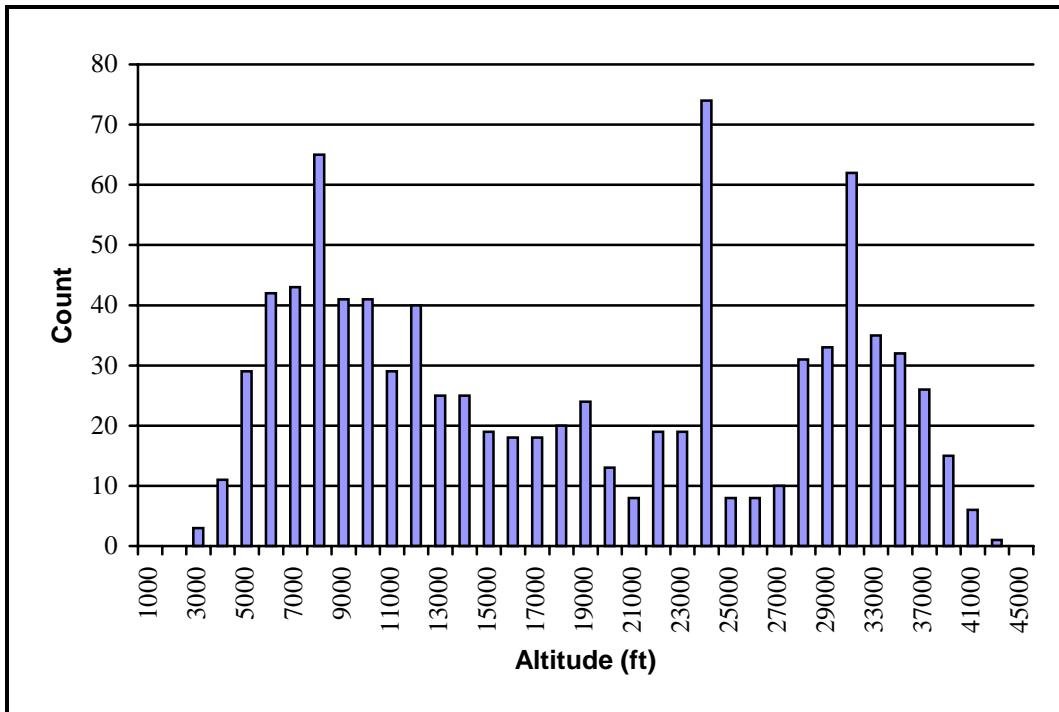


Figure 2: Airspace to Airspace Encounters by Altitude

### 5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

**Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	5	6	18	29
Cruise	15	34	33	82
Descend	2	3	2	7
Total	22	43	53	118

**Table 8: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts**

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	8	0	0	8
Cruise	0	0	0	0
Descend	4	0	0	4
Total	12	0	0	12

**Table 9: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles**

Vertical Phase	Count
Climb	11
Cruise	4
Descend	3
Total	18

## 6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

### 6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

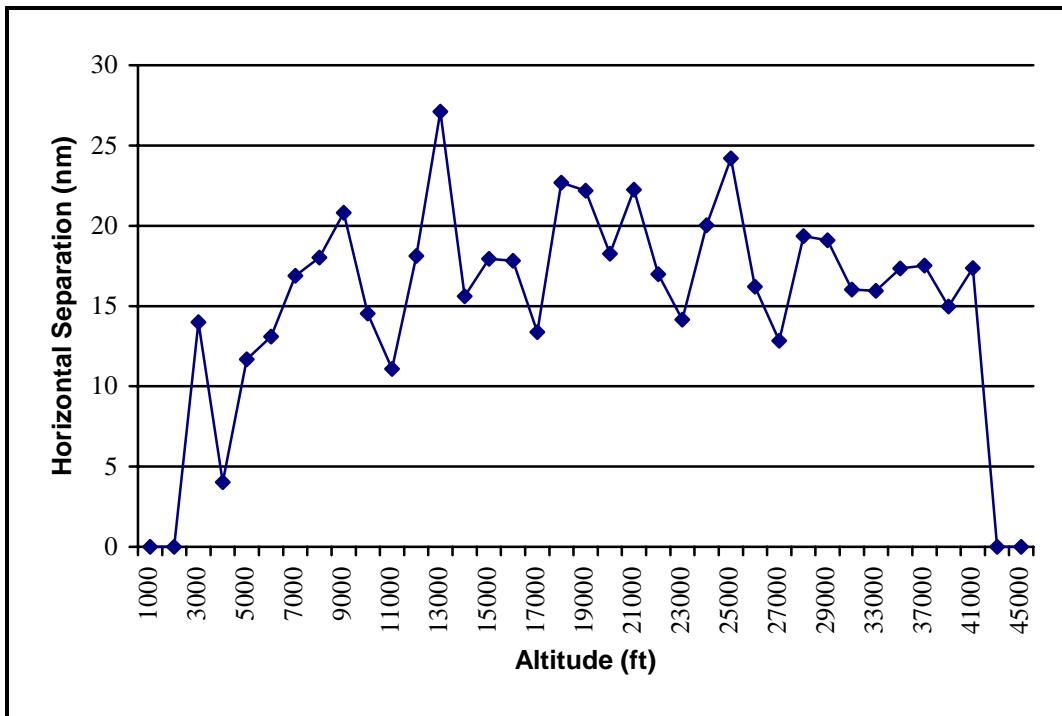


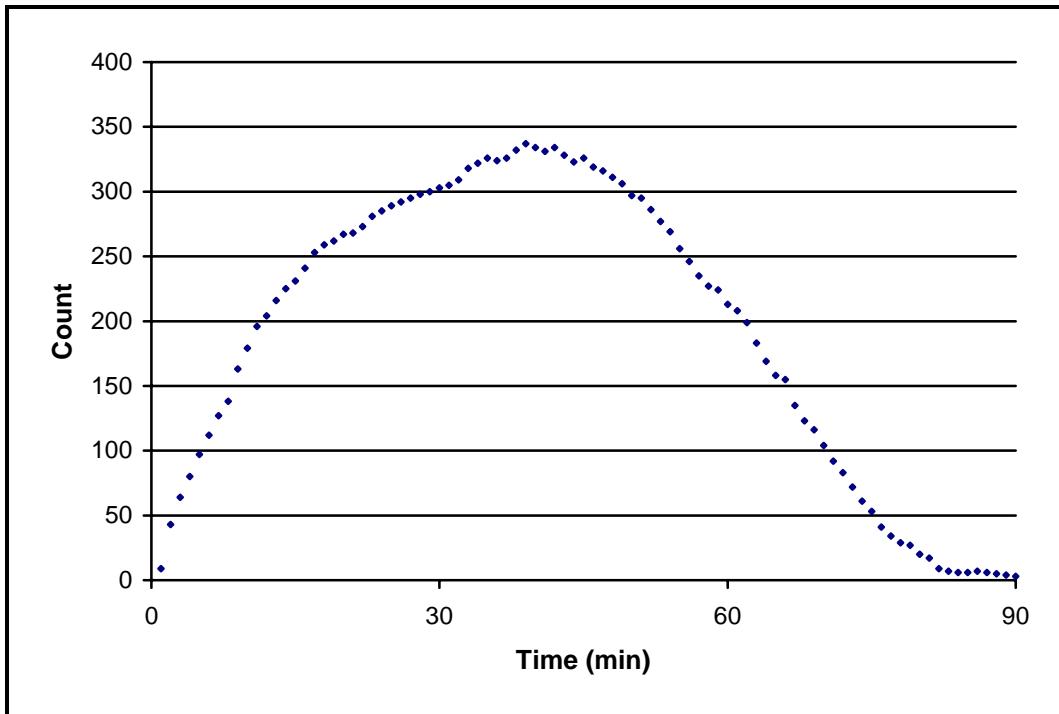
Figure 3: Average Horizontal Separation by Altitude for All Hours

## 6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

**Table 10: Statistics on Active Flights per Minute Increment**

Count Average	Standard Deviation	Maximum Count	Minimum Count
192.60	115.06	337	3



**Figure 4: Count of Active Flights per Minute Increment**

### 6.3 Flight Type and Sector Penetration

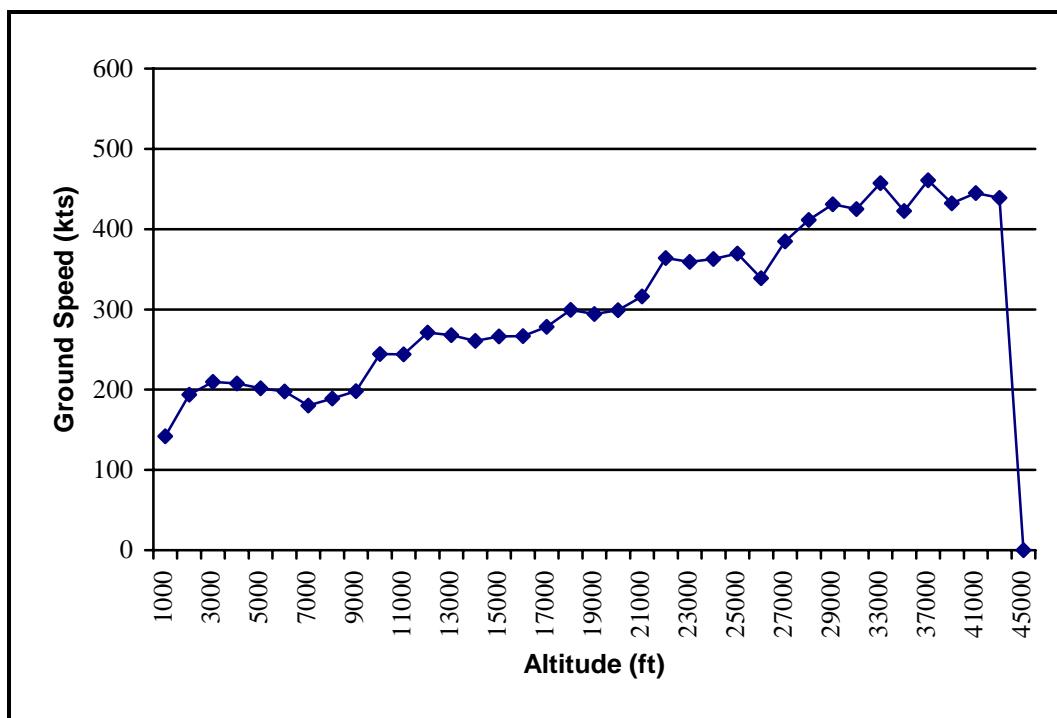
This section corresponds to Section 3.3.3 of Reference[1].

**Table 11: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type**

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	1.926	1.967	1.763	2.238	2.092
Average Time in Center (sec)	1192.222	969.583	1335.526	1478.971	1309.913
Average Time in Sector (sec)	605.769	475.932	671.194	655.345	612.601
Percentage by Flight Type	18.700	20.800	6.600	53.900	100.000

### 6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.



**Figure 5: Average Ground Speed by Altitude for All Hours**

## 6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

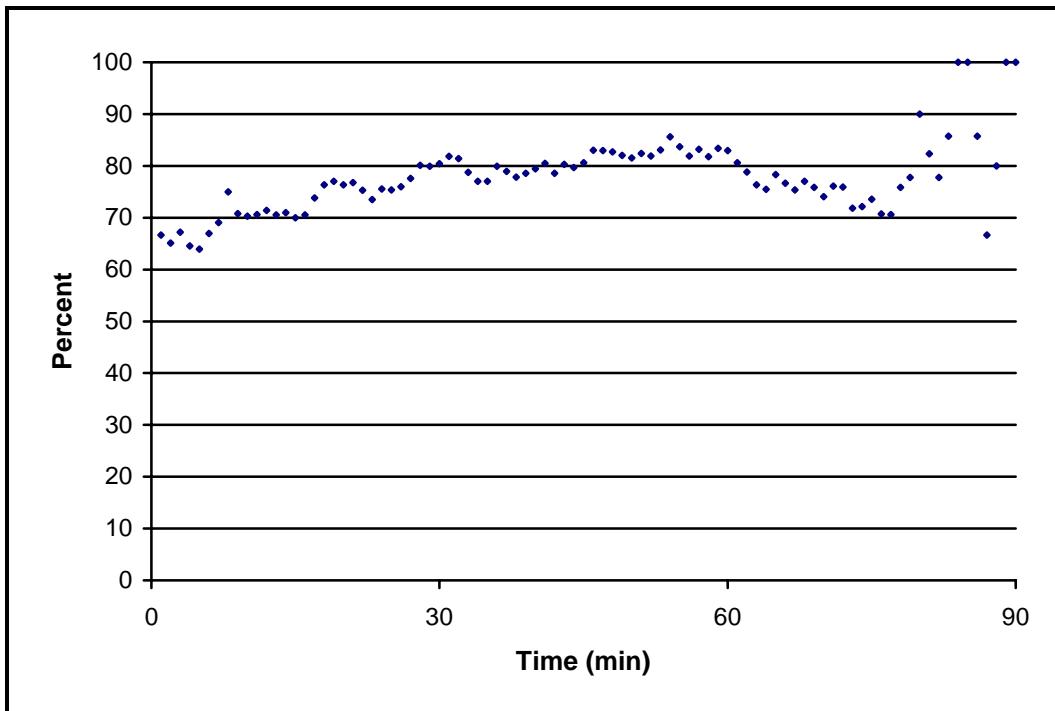


Figure 6: Percentage of Track Points in Center to APD Zone per Minute Increment

## 6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 12: Statistics on Interim Altitude Messages<sup>5</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
412	2.631	0.920	7	1

## 6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 13: Statistics on Amendment Messages per Flight<sup>6</sup>

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
254	2.035	1.258	7	1

<sup>5</sup> Statistics on flights with interim altitude messages only

<sup>6</sup> Statistics on flights with flight plan amendments only

## 6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

**Table 14: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight**

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	2605	656	3261
DES	2559	522	3081
LEV	1061	662	1723
Total	6225	1840	8065

**Table 15: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase**

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	32.300	8.134	40.434
DES	31.730	6.472	38.202
LEV	13.156	8.208	21.364
Margin (%)	77.185	22.815	100.000

## 7 Aircraft Distributions

This sections provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

### 7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

**Table 16: Count by Aircraft Type**

Aircraft Type	Count	Percentage of Total
J	404	68.243
P	71	11.993
T	79	13.345
Unknown	38	6.419
Total	592	100.000

## 7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

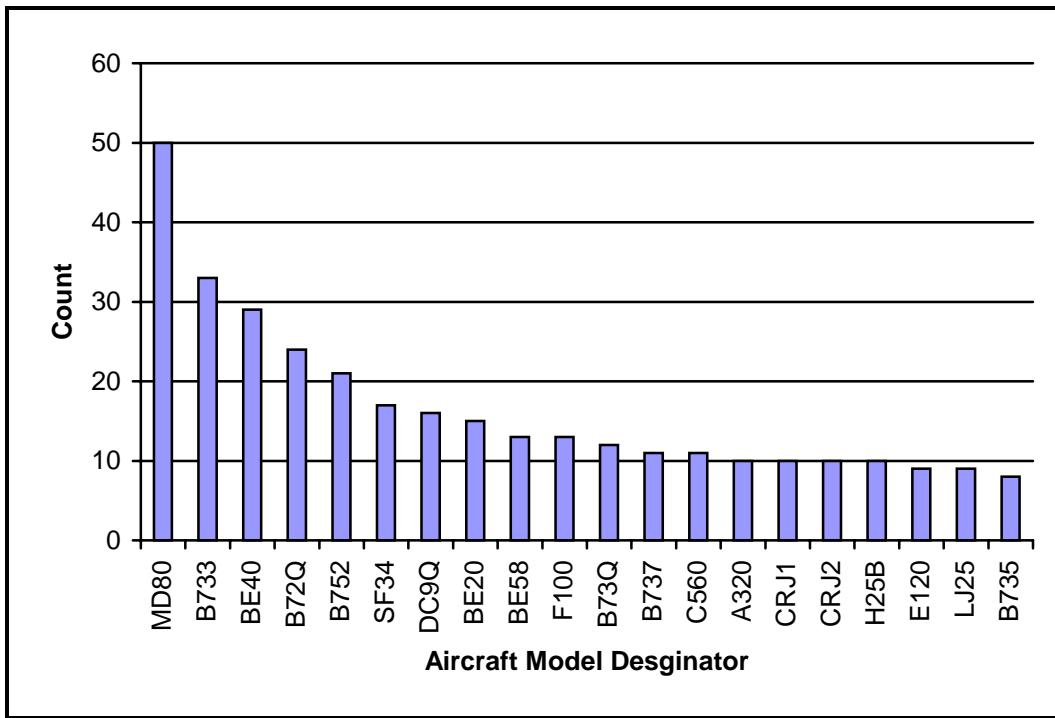


Figure 7: Count of Top Twenty Aircraft Models

### **7.3 Navigational Equipage**

This section corresponds to Section 3.4.3 of Reference[1].

**Table 17: Count by Aircraft Navigational Equipage Type**

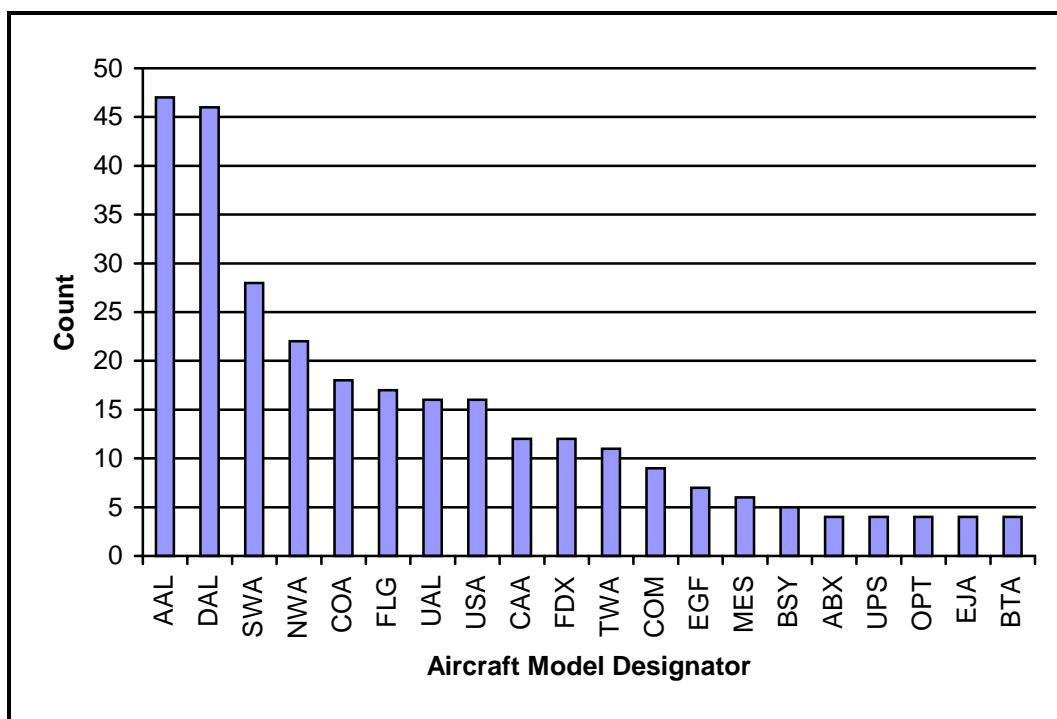
Nav. Equip. Designator	Count	Percentage of total
G	164	27.703
I	142	23.986
A	116	19.595
E	75	12.669
F	62	10.473
R	19	3.209
P	3	0.507
W	3	0.507
Q	3	0.507
U	2	0.338
B	1	0.169
T	1	0.169
C	1	0.169
Total	592	100.000

## 7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

**Table 18: Count by Carrier Type**

Category	Count	Percentage of Total
Commercial	346	58.446
General Aviation	210	35.473
Other <sup>7</sup>	36	6.081
Total	592	100.000



**Figure 8: Count by Top Twenty Air Carriers**

<sup>7</sup> Includes military and aircraft with unrecognized designators

## 8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

### 8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

**Table 19: Statistics on Lateral Flight Plan Adherence by Altitude<sup>8</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	16	21	11	16.081	2.590
18000	12	38	13	18.920	3.205
33000	23	51	13	24.926	5.465
45000	13	59	19	28.395	11.653
Total	64				

### 8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

**Table 20: Statistics on Vertical Flight Plan Adherence by Altitude<sup>9</sup>**

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	223	37017	316	5500.086	5069.470
45000	78	20000	542	4818.362	3635.393
Total	301				

<sup>8</sup> Statistics determined on tracks out of lateral adherence only.

<sup>9</sup> Statistics were determined on tracks out of vertical adherence only.

## Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

**Table 21: Statistics on Aircraft Encounters by Altitude Interval for All Hours**

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	1	13.992	0.000
4000	1	4.035	0.000
5000	2	11.676	12.482
6000	7	13.101	6.061
7000	17	16.882	8.006
8000	4	18.027	7.468
9000	5	20.816	6.745
10000	3	14.538	7.004
11000	1	11.090	0.000
12000	5	18.126	5.194
13000	1	27.103	0.000
14000	8	15.599	6.516
15000	2	17.940	1.678
16000	14	17.815	7.970
17000	18	13.380	8.407
18000	4	22.690	7.982
19000	5	22.188	5.840
20000	10	18.258	5.715
21000	8	22.244	6.020
22000	8	16.985	6.062
23000	10	14.150	9.103
24000	5	20.040	8.385
25000	4	24.194	5.295
26000	6	16.202	6.843
27000	6	12.842	7.699
28000	23	19.354	6.552
29000	33	19.101	6.940
31000	92	16.025	8.186
33000	128	15.940	8.666
35000	83	17.343	8.253
37000	60	17.520	8.527
39000	24	14.965	8.340
41000	7	17.368	6.400
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	605		

## Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

**Table 22: Statistics on Ground Speed by Altitude for All Hours**

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	142.067	3.900
2000	16	193.915	34.846
3000	52	209.533	47.019
4000	92	207.762	45.213
5000	122	201.878	46.781
6000	154	197.675	48.635
7000	179	180.112	43.622
8000	216	189.118	50.571
9000	217	198.291	51.834
10000	204	244.404	76.255
11000	204	243.819	70.338
12000	204	271.009	62.886
13000	196	267.968	70.692
14000	196	260.539	76.465
15000	196	266.217	71.677
16000	197	266.849	70.144
17000	187	278.228	65.853
18000	183	299.370	71.157
19000	183	294.290	78.604
20000	183	299.085	82.734
21000	174	316.084	87.029
22000	170	363.837	68.457
23000	163	359.323	75.831
24000	163	362.891	80.922
25000	155	369.620	80.271
26000	156	338.997	92.526
27000	153	384.838	76.184
28000	152	411.324	59.546
29000	157	430.946	59.848
31000	167	424.824	45.030
33000	171	457.110	49.837
35000	138	422.550	42.838
37000	95	460.983	52.134
39000	54	432.046	42.156
41000	22	444.814	49.649
43000	6	438.827	29.963
45000	0	0.000	0.000

## Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

**Table 23: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight**

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	1	2
	DES	0	0
	LEV	1	2
2000	ASC	1	3
	DES	6	3
	LEV	4	9
3000	ASC	14	14
	DES	14	16
	LEV	21	18
4000	ASC	22	23
	DES	34	32
	LEV	47	29
5000	ASC	29	23
	DES	43	38
	LEV	75	32
6000	ASC	41	27
	DES	58	32
	LEV	88	29
7000	ASC	38	30
	DES	77	39
	LEV	94	31
8000	ASC	50	30
	DES	100	56
	LEV	97	32
9000	ASC	31	18
	DES	100	61
	LEV	101	16
10000	ASC	37	16
	DES	95	44
	LEV	96	24
11000	ASC	17	11
	DES	103	25
	LEV	99	22
12000	ASC	20	11
	DES	105	21
	LEV	106	13

13000	ASC	10	6
	DES	110	13
	LEV	100	10
14000	ASC	13	8
	DES	113	11
	LEV	97	8
15000	ASC	16	5
	DES	110	18
	LEV	95	11
16000	ASC	19	11
	DES	108	19
	LEV	90	10
17000	ASC	16	8
	DES	103	12
	LEV	84	8
18000	ASC	20	12
	DES	102	15
	LEV	82	9
19000	ASC	14	6
	DES	100	14
	LEV	88	15
20000	ASC	19	11
	DES	94	6
	LEV	89	17
21000	ASC	8	6
	DES	90	11
	LEV	93	13
22000	ASC	11	6
	DES	86	9
	LEV	90	13
23000	ASC	17	8
	DES	83	12
	LEV	85	14
24000	ASC	29	17
	DES	83	11
	LEV	88	12
25000	ASC	18	10
	DES	81	13
	LEV	80	9
26000	ASC	16	10
	DES	84	11

	LEV	81	9
27000	ASC	20	11
	DES	80	9
	LEV	81	15
28000	ASC	44	12
	DES	81	10
	LEV	77	18
29000	ASC	60	30
	DES	78	15
	LEV	73	15
31000	ASC	76	47
	DES	76	25
	LEV	76	19
33000	ASC	97	69
	DES	71	26
	LEV	70	13
35000	ASC	100	65
	DES	60	12
	LEV	54	13
37000	ASC	67	55
	DES	41	13
	LEV	34	9
39000	ASC	43	27
	DES	24	3
	LEV	15	3
41000	ASC	21	12
	DES	10	1
	LEV	8	2
43000	ASC	6	2
	DES	2	0
	LEV	0	0
45000	ASC	0	0
	DES	0	0
	LEV	0	0

## Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 24: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	50	8.446
B733	33	5.574
BE40	29	4.899
B72Q	24	4.054
B752	21	3.547
SF34	17	2.872
DC9Q	16	2.703
BE20	15	2.534
BE58	13	2.196
F100	13	2.196
B73Q	12	2.027
B737	11	1.858
C560	11	1.858
A320	10	1.689
CRJ1	10	1.689
CRJ2	10	1.689
H25B	10	1.689
E120	9	1.520
LJ25	9	1.520
B735	8	1.351
C550	8	1.351
E145	8	1.351
B763	7	1.182
BE9L	7	1.182
C650	7	1.182
CL60	7	1.182
FA20	7	1.182
BA46	6	1.014
C340	6	1.014
LJ35	6	1.014
LJ60	6	1.014
C210	5	0.845
C414	5	0.845
C525	5	0.845
SW4A	5	0.845
WW24	5	0.845
A319	4	0.676

B734	4	0.676
B772	4	0.676
BE10	4	0.676
DC10	4	0.676
LJ31	4	0.676
PA34	4	0.676
B722	3	0.507
B762	3	0.507
BE30	3	0.507
BE35	3	0.507
BE36	3	0.507
BE55	3	0.507
C130	3	0.507
C500	3	0.507
DC9	3	0.507
FA10	3	0.507
FA50	3	0.507
GLF3	3	0.507
GLF4	3	0.507
PA31	3	0.507
PA32	3	0.507
PAY1	3	0.507
A306	2	0.338
AT38	2	0.338
B350	2	0.338
B712	2	0.338
B732	2	0.338
C310	2	0.338
C402	2	0.338
C421	2	0.338
C441	2	0.338
E135	2	0.338
F900	2	0.338
H25	2	0.338
JS32	2	0.338
LJ24	2	0.338
LR60	2	0.338
M20P	2	0.338
MO20	2	0.338
MU2	2	0.338
B734	4	0.676
B772	4	0.676

PA24	2	0.338
PAY2	2	0.338
SBR1	2	0.338
A310	1	0.169
AC90	1	0.169
AEST	1	0.169
AT43	1	0.169
B190	1	0.169
B2	1	0.169
B52	1	0.169
B727	1	0.169
B738	1	0.169
B757	1	0.169
BE33	1	0.169
BL26	1	0.169
C208	1	0.169
C425	1	0.169
C501	1	0.169
C750	1	0.169
C82R	1	0.169
C9	1	0.169
CVLP	1	0.169
DH8B	1	0.169
F15	1	0.169
GLS2	1	0.169
H25C	1	0.169
J328	1	0.169
JS41	1	0.169
K35R	1	0.169
L101	1	0.169
L39	1	0.169
LJ45	1	0.169
LR24	1	0.169
M20C	1	0.169
M20T	1	0.169
MD11	1	0.169
P28R	1	0.169
P32R	1	0.169
PA27	1	0.169
PA28	1	0.169
PA24	2	0.338
PAY2	2	0.338

PA30	1	0.169
PA46	1	0.169
PAY3	1	0.169
SW4	1	0.169
T37	1	0.169
T38	1	0.169
Total	592	100.000